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RESEARCH ARTICLE

# Production, sensory and proximate evaluation of biscuit from blends of wheat, sweet potatoes and tiger nut flour

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**ABSTRACT**

Biscuits are one of the low cost processed foods that are most widely consumed all over the world. Biscuits have some notable advantages over conventional snacks in that it is cheaper, easy to use at home or even during travel, easily available in wide variety of shapes, sizes, tastes, packs, and appeals to all age groups. This study assessed the quality of biscuits produced from blends of wheat, sweet potatoes and tiger nut flour. Four blends of these flours were prepared in the proportions: 100:0:0, 50:40:10, 45:40:15 and 50:30:20% respectively and designated as ABC, DEF, GHI and JKL respectively. These blends were used to bake biscuits and the sensory and proximate attributes were examined. The results of sensory analysis showed that the general acceptability of the biscuits ranged from 6.4-7.3 with samples DEF and JKL having high preference with acceptability values of 7.1 and 7.3 respectively while all samples in terms of appearance were significantly different ($p < 0.05$). Results of proximate analysis showed that moisture content of the biscuit samples ranged from 5-11%; fat, 13-23%; protein, 9.87-14.71%; carbohydrate, 52.86-59.26%; crude fibre, 1.77-2.89% and ash, 2.00-4.95%. Sample GHI has the highest value for crude fibre and ash while sample JKL has the least moisture content.

**Keywords**: Biscuit, Proximate Analysis, Sweet Potatoes, Tiger Nut Flour

## 1. INTRODUCTION

Biscuit is a flat, crisp flour-based baked food product usually consumed as snacks. The principal ingredients for biscuits are flour, fat, sugar and water; while other ingredients include milk, salt, flavouring agent and aerating agent [1]. In Nigeria, biscuits are second to bread as the most consumed cereal foods, because they are readily available in local shops as ready to eat, convenient and inexpensive food products containing digestive and dietary principles of vital importance [2]. Biscuits are nutritive snacks made from unpalatable dough that is transformed into appetizing products through the application of heat in the oven in the process of baking [3]. Biscuits are considered as energy giving food because they are rich source of fat and carbohydrate and they are also a good source of protein and minerals [4]. Consumption of biscuits and

similar foods made from wheat has become so popular in Nigeria that total elimination of wheat from the dietary pattern of biscuit could have nutritional and socio economic implications. Ready-to-eat baked products consumption is growing rapidly in Nigeria resulting to increasing reliance on imported wheat for their production [5]. In Nigeria, staple crops that are grown other than wheat such as cassava, yam or sweet potatoes, tiger nut bread fruits, rice and cereals can be used for baked foods [6]. The inclusion of other staple crops such as sweet potatoes and tiger nut which are locally grown and readily available in the production of baked foods such as biscuit will boost Nigeria's economy through job creation, reduction in importation of wheat and the likes. Efforts are therefore, made to partially replace wheat flour with non-wheat flours in order to increase the utilization of Nigeria's indigenous crops as well as contribute to lowering cost of production of bakery products [7]. Many researchers have delved into studying the physical and baking properties of composite biscuits from starchy staples like cassava, cocoyam and plantain [8]. Oluwole and Karim (2006) [9] produced biscuit from various blends of Bambara, cassava and wheat flours respectively, Duru *et al* (2019) [10] produced biscuit from wheat and tiger nut while Onabanjo and Ighere (2014) [11] produced biscuit from a blend of sweet potatoes and wheat flour.

Sweet Potatoes (*Ipomoea batatas*) is an economical and healthful food crop containing beta-carotene and substantial amounts of ascorbic acid and minerals [12]. Potatoes being the seventh most important food crop in the world have a large potential to be used as a food in developing nations with limited resources because of its short maturity time and ability to grow under diverse climatic condition and on less fertile soil as well as its ability to grow all year round. Potatoes chips, starch, flour, vegetables have been identified among the most promising options for sweet potato products [13]. Sweet potato flour has vast applications and can serve as a source of energy and nutrients and can add natural sweetness, color, flavor and dietary fiber to processed food products [12, 14].

Tiger-nut (*Cyperus esculentus*) is an underutilized crop which has been found to be cosmopolitan perennial crop of the same genus as the papyrus plant [15]. The high crude lipid, carbohydrate contents and its fairly good essential amino acid composition makes it a valuable source of food for man and can be consumed raw or processed into other valuable products. According to Belewu & Abodunrin (2009) [16] and Adejuyitan *et al* (2009) [17], tiger-nut produces high quality oil about 25% of its content and oil was implicated as lauric acid grade oil, non- acidic, stable and very low unsaturation. *Cyperus esculentus* has been reported to be "health" food since consuming it can prevent heart disease and thrombosis (blood clot formation in the blood vessel) [18]. It is considered a good flour additive for bakery industry since it contains high amount of natural sugar thereby avoiding the necessity of adding extra sugar and the tiger-nut Flour does not lose any of its nutritious properties in the milling process [19]. This study therefore aims

at improving the nutritional and sensory attributes of biscuits by conditioning them with sweet potatoes and tiger nut.

This study aimed at producing biscuit from blends of wheat, sweet potatoes and tiger nut flour and evaluates its, sensory and proximate analysis.

## 2. METHODS AND MATERIALS

### *2.1. Sample Collection*

Wheat flour, tiger nuts (*Cyperus esculentus*) and Sweet potato tubers (Ipomoea batatas) used for this study were purchased from Eke market at Ekwulobia, Anambra State, Nigeria. The wheat flour was a commercial baker's grade milled by Golden Penny, Nigeria. Other ingredients such as sugar, margarine, fresh eggs, sodium bicarbonate (baking powder) were also purchased from the market and transported to the Department of Food Technology, Federal Polytechnic Oko. Nigeria.

### *2.2. Sample Preparation*

#### *2.2.1. Sweet Potato Flour*

The method described by Onabanjo and Ighere (2014) [11] was used. The fresh sweet potatoes tubers (*Ipomoea batatas*) were thoroughly washed twice to remove dirt and soil, peeled, washed, sliced, blanched at 62 °C for 10 min, sun dried for 2 weeks then milled, sieved through a 60 mm mesh sieve to obtain flour of uniform particle size and packaged in clean, dry, air tight container.

#### *2.2.2. Tiger Nut Flour*

The method described by Eke-Ejiofor and Deedam (2015) [20] was adopted for tiger nut flour production. The dry brown tiger nuts were sorted to remove particles, thoroughly washed to remove dirt, dried in an oven at 105 °C for 25 min, cooled, milled, sieved and packaged in clean, dry plastic containers and covered tightly to avoid moisture absorption.

### *2.3. Formulation of Flour Blends*

Four blends were prepared by mixing wheat flour with sweet potato flour and tiger nut flour respectively. Flour was in the following percentage proportions of 100:0:0, 50:40:10, 45:40:15 and 50:30:20. Each of these blends were mixed with Sugar (30g), baking powder (1.5g), Salted butter (10g), Eggs (30g), Shortening (10g) and milk powder (5g) and were for baking biscuit (table 1).

### *2.4. Proximate Analysis of Biscuit*

Proximate analysis of the samples was carried out using the AOAC method [21] for moisture, ash, crude fat, protein and fiber. Total

**Table 1**. Composition of Wheat/Sweet Potatoes/Tiger Nut Flour Blends for Biscuit Production

| Ingredients | Samples in grams | | | |
|---|---|---|---|---|
| | ABC* | DEF** | GHI# | JKL## |
| Wheat Flour | 100 | 50 | 45 | 50 |
| Sweet potato flour | 0 | 40 | 40 | 30 |
| Tiger nut flour | 0 | 10 | 15 | 20 |

*ABC = 100% wheat: 0% sweet potatoes: 0% tiger nut flour
**DEF = 50% wheat: 40% sweet potatoes: 10% tiger nut flour
#GHI = 45% wheat: 40% sweet potatoes: 15% tiger nut flour
##JKL = 50% wheat: 30% sweet potatoes: 20% tiger nut flour

carbohydrate was calculated by difference.

*2.5. Sensory Evaluation*

Biscuit samples were subjected to sensory evaluation within 24 hours after production. The following attributes namely: taste, aroma, texture, appearance/colour and overall acceptability were assessed on the biscuit samples using a 9-point hedonic scale with 9 as extremely liked and 1 as extremely disliked [22]. Twenty five (25) panellists familiar with biscuit were involved in the assessment. The choice for the panellists were based on availability and interest and care was taken to ensure that they were neither sick nor allergic to baked products, The panellists were instructed to rinse their mouth with water after each tasting.

*2.6. Statistical Analysis*

Results were analyzed statically using Analysis of Variance (ANOVA) and means were separated by Least Significant Difference (LSD) procedure [22].

## 3. RESULTS AND DISCUSSION

The proximate composition of the various flour blends are shown in Table 2. The moisture content ranged from 5.00 - 11.00% showing a decrease in substitutions with increase in tiger nut concentration. This is in line with the findings of Duru *et al* (2019) [10] who also reported a decrease in moisture content with increased tiger nut substitution. The result of the moisture content obtained in this study showed that sample JKL will have longer shelf life than the other samples. It has been reported that moisture content of biscuits should fall within 1 – 5% moisture. This low moisture of biscuits ensures that they are generally free from microbiological spoilage and have long shelf life if they are protected from absorbing moisture from damp surroundings or atmosphere [19].

The results of the protein content showed that ABC had the highest protein content while JKL had the least protein content. This could be attributed to the high protein content in wheat and it is in line with the findings of [19]. However, the result of the protein content obtained from the composite flours is of appreciable value, hence, tiger nut and sweet potatoes can be good alternative to wheat flour as they are gluten free and good for people who cannot take gluten in their diet.

Fat content increased with an increase in substitution with tiger nut flour with sample JKL having the highest value. The high fat content as recorded in the sample with highest tiger nut substitution can be attributed to the fact that tiger nut flour is rich in oil and none of its content has been proven to be lost during processing. High fat content of tiger nut flour boosts its value as alternative food supplement in human and livestock diets [22-23]. The high fat content with corresponding increase in tiger nut substitution is also reported earlier [10]. Fiber and ash contents were highest for sample GHI and least for sample ABC, this could be attributed to the increase in both potatoes and tiger nut substitution. This result is also in line with the findings of Duru *et al*, (2019) [10]. Both tiger nut and sweet potatoes have been proven to be rich in minerals and fibre, hence,

the high ash and crude fibre content observed in this study with increased substitution of these flours. The ash content of any food material is a true representation of the inorganic elements obtained after the combustion of the organic materials in the food [24]. These inorganic materials comprises of mineral element such as calcium, magnesium, iron, phosphorus, potassium etc which are important for building rigid structures and regulatory functioning of the body [19].

Crude fiber composition on the other hand is a measure of quality of indigestible cellulose, pentose, lignin and other components of food. Crude fiber though having little food value provides bulk necessary for peristaltic action in the intestinal tract [25].

The carbohydrate contents were highest in terms of all proximate composition parameters as determined in this study. DEF and GHI have the highest and least carbohydrate values respectively (table 2). The result of the proximate evaluation showed that the samples differed significantly ($p < 0.05$) for all the parameters tested.

The results of sensory evaluation of wheat/sweet potatoes/tiger nut blends showed significant difference ($P \leq 0.05$) at all levels of substitution in terms of colour/appearance while samples DEF and JKL do not show significant difference ($P > 0.05$) in terms of taste, texture and general acceptability (table 3). Substitution levels of 50% wheat: 40% sweet potatoes: 10% tiger nut (DEF) and 50% wheat: 30% sweet potatoes: 20% tiger nut (JKL) were preferred more than the other samples in terms of generally acceptability. The study has shown that wheat, sweet potato, tiger nut composite flour has the potential of producing biscuits of acceptable quality without altering the sensory properties of the

**Table 2**. Proximate Composition of Biscuits from Blends of Wheat, Sweet Potatoes and Tiger Nut Flour

| Samples | Fat | Moisture | Fibre | Protein | Ash | Carbohydrate |
|---|---|---|---|---|---|---|
| ABC | $13.00^{d}\pm0.10$ | $11.00^{a}\pm0.10$ | $1.77^{d}\pm0.10$ | $14.71^{a}\pm0.10$ | $2.00^{d}\pm0.10$ | $57.52^{b}\pm0.10$ |
| DEF | $15.00^{c}\pm0.10$ | $10.00^{b}\pm0.10$ | $2.58^{c}\pm0.10$ | $10.16^{c}\pm0.10$ | $3.00^{c}\pm0.10$ | $59.26^{a}\pm0.10$ |
| GHI | $21.00^{b}\pm0.10$ | $8.00^{c}\pm0.10$ | $2.89^{a}\pm0.10$ | $10.30^{b}\pm0.10$ | $4.95^{a}\pm0.10$ | $52.86^{d}\pm0.10$ |
| JKL | $23.00^{a}\pm0.10$ | $5.00^{d}\pm0.10$ | $2.77^{b}\pm0.10$ | $9.87^{d}\pm0.10$ | $4.00^{b}\pm0.10$ | $55.36^{c}\pm0.10$ |

* Means with the same superscript in the same column are not significantly ($p < 0.05$) different.

**Table 3.** Sensory evaluation of Biscuits Produced from Wheat, Sweet Potatoes and Tiger Nut Flour Blends

| Samples | Appearance | Aroma | Taste | Texture | General Acceptability |
|---|---|---|---|---|---|
| ABC | $6.40^{ab}\pm0.17$ | $6.20^{ab}\pm2.14$ | $6.50^{ab}\pm0.16$ | $6.50^{a}\pm1.36$ | $6.40^{ab}\pm0.42$ |
| DEF | $7.20^{a}\pm1.15$ | $6.80^{a}\pm1.14$ | $7.40^{a}\pm1.18$ | $7.00^{a}\pm2.13$ | $7.10^{a}\pm0.32$ |
| GHI | $6.90^{a}\pm2.12$ | $6.40^{a}\pm0.12$ | $6.40^{b}\pm0.25$ | $6.20^{ab}\pm0.14$ | $6.50^{a}\pm0.61$ |
| JKL | $7.40^{a}\pm0.21$ | $6.60^{a}\pm0.11$ | $7.80^{a}\pm2.51$ | $7.20^{a}\pm1.19$ | $7.30^{a}\pm1.31$ |

* Means with the same superscript in the same column are not significantly ($p < 0.05$) different.
ABC = 100% wheat flour
DEF = 50% Wheat Flour: 40% Sweet Potatoes: 10 Tiger Nut Flour
GHI = 45% Wheat Flour: 40% Sweet Potatoes: 15% Tiger Nut Flour
JLK = 50% Wheat Flour: 30% Sweet Potatoes: 20% Tiger Nut Flour

final products. These substitutions also served as conditioners, improving the nutritional value of biscuits as well as channelling our nature's goodness in producing ready to eat snacks whose consumptions are on the increase in Nigeria and as well reduce total dependency on wheat which in turn will reduce production cost by reducing importation cost.

## 4. CONCLUSION

The results from this research have shown that biscuits with good nutritional profile can be produced from a blend of wheat/sweet potatoes and tiger nut flour and should be adopted for large scale production. It is also evident that reduction in moisture content with increase in substitution with sweet potatoes and tiger nut can also improve the shelf life of the biscuit. Hence, increased awareness and adoption of these flour substitutions in confectionary industries should be encouraged.

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## 6. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

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